Claims

1) An efficient electrostatic spray installation that can spray a wide range of conductive materials effectively while creating very small droplets, with conductivities in from about 7,000 pico Siemens and greater.

2) A compact system in which one, two or more parallel sprays can be obtained at close proximity, in the order of 30 to 40 mm of each other, in a compact package.

3) A system as described in claims 1 or 2 in which the total spray length can be made to any practical length, with no interruption (gaps) in the spray, or with interruptions and or with areas with lower or higher application rates.

4) A system as claimed in claims 1, 2 or 3 which is substantially built from non-conductive materials, and where in flow distribution modules are fixed to a member that has one or more strips or bands of a conductive material.

5) A system as claimed in claims 1, 2, 3 or 4, wherein the flow distribution modules are each supplied separately by a controlled flow, and wherein different materials can be sprayed through each module or through a combination of modules if so required.

6) A system as claimed in any one of claims 1 to 5, wherein the flow distribution module contains a distribution groove that supply a number of smaller grooves parallel and in the direction of the electrostatic field, thereby ensuring an even spray distribution over the width of a module.

7) A spray system as claimed in any one of claims 1 to 6, wherein the target bars are separate from the catch tray and shaped according to the spray pattern to be obtained. Recessed areas or gaps can be made where no spray is required. This together with properly sized flow distribution modules then defines a gapped spray.

8) A spray system as claimed in any one of claims 1 to 7 in which the spray can be made to follow a contour by properly sizing of the main vertical member and the use of shaped flow distribution modules.

9) A system as claimed in any one of claims 1 to 8, that has low power consumption and a low accumulation of electric charge by keeping the charged conductive parts to a minimum, by providing the minimum number and longest paths to ground, and by the electrical insulation of the flowable material supply system.

10) A system as claimed in any one of claims 1 to 9, wherein the flowable material

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supply system consists of one or more pumps, reservoirs, valves and supply lines that are electrically insulated, and of which the electrical insulation is maintained during operation while the system is being supplied with flowable material.

11) A system as described in any one of claims 1 to 10 in which the flowable material supply system is electrically insulated and can be heated by a hot gas such as air.

12) A system as described in any one of claims 1 to 11 in which the alignment of the flow paths in the flow distribution modules with the electrostatic field is followed by some distance of flow over a lip made of an insulating material to provide a good distribution of the flow over the width of each flow distribution module and between flow distribution modules, and to generate the maximum of ligaments to obtain the finest droplets.

13) A system as described in any one of claims 1 to 12 in which the finest and most mono disperse spray pattern is obtained by a ligament flow with as many ligaments as possible, by using a high charging voltage, and provide a sufficient amount of free lip distance and a thin lip with a sharp edge.

14) A system as described in any one of claims 1 to 13 in which the charge imparting electrode is flat, thin, of a simple geometry and not exposed, and being covered by a flow distribution module.

15) A system as described in any one of claims 1 to 14 in which drip proof stop of the spray action is obtained by the control of the flow to the flow distribution modules in two directions to be able to provide temporary 'suck back'.

16) A system as described in any one of claims 1 to 15 in which drip proof stop of the spray is obtained by combining temporary 'suck back' of the flow to a flow distribution module with the quick removal of the high voltage from the charging strip by means of ground switch.

17) A system as described in any one of claims 1 to 16 in which drip proof stop is further facilitated by the location of the inlet of each distribution module below the feed line of the grooves that are aligned with the electrostatic field, ensuring the minimum of flowable material to be available for dripping.

18) A system as described in any one of claims 1 to 17 in which the flowable material supply and spray system is heated, to allow for spraying of higher melting point materials, or to reduce the viscosity for obtaining a better quality spray, wherein optionally, hot air is circulated through the spray system enclosures, or the spray assembly is heated by a liquid through a separate channel, or by infra red radiation.

19) A system as described in any one of claims 1 to 18 in which a precise stacked metering pump supplies various flow distribution modules over the length of a spray assembly.

20) A system as described in any one of claims 1 to 19 in which the precise stacked metering pump is driven by a precisely controlled motor or motor gearbox combination, ensuring precisely controlled flow to each flow distribution module.

21) A system as described in any one of claims 1 to 20 in which the outlet lines of the precise stacked metering pump are provided with valves so that individual flow distribution modules can be supplied with flowable material or be disconnected from the supply, by diverting the flow from the outlet lines back to the feed tank.

22) A system as described in any one of claims 1 to 21 which is used to spray flowable material on a belt or roll which subsequently transfers this material to a web of material to be coated with the flowable material.

23) A system as described in any one of claims 1 to 22 in which the two sides of a web are coated by using two spray assemblies which spray downwards and through which the web is guided by rollers in an S configuration

24) A system as described in any one of claims 1 to 23 in which the two sides of a web are coated by using two spray assemblies which spray downwards and through which the web is guided by rollers in an C configuration

25) A system as described in any one of claims 1 to 24 in which the flowable material is heated when being sprayed, but then subsequently cooled with a cold gas such as cold air to provide a lower temperature of the flowable material when it reaches the target.

26) A system as described in any one of claims 1 to 25 in which the spray system with flow distribution modules is illuminated in the area on the lips where ligament flow occurs during spraying.

27) A system as described in any one of claims 1 to 26 in which the spray system with flow distribution modules is observed in the area on the lips where ligament flow occurs by one or more video cameras. The cameras are connected to a computer. The bright points are counted and variations in the count are calculated by the computer and used as a measure for the quality of the spray.

28) A system as described in any one of claims 1 to 27 in which grounding switches are provided as a means to remove high voltages quickly from the charged parts.

29) A system as described in any one of claims 1 to 28 which is automated and controlled by a computer system.

30) A system as described in any one of claims 1 to 29 which is preceded by a dust removal device such as a web cleaner, or a separate electrostatic device for dust removal.

31) A system as described in any one of claims 1 to 30 in which atomization by a gas such as air is incorporated.

32) A system as described in any one of claims 1 to 31 in which mechanical energy such as vibration is used in addition to affect the spray characteristics.

33). An electrostatic flow distribution and charging system for spraying flowable materials by distribution and charging to a suitable high voltage and the spraying of the material by a multiplicity of one or more parallel ligamental streams, wherein said systems all materials are electrically insulated except for a conductive surface and the electrical connections to such surface whereby the material is sprayed with minimum loss from electrical currents through the assembly, the flow of material being distributed and guided through grooves in the non-conductive flow distribution flow modules and over the electrically conductive part of the assembly substantially parallel with the electrostatic field, each groove in the flow distribution modules being aligned with the direction of the electrostatic field and the application of the electrostatic field providing a positive force or pressure to move the material that is sprayed through the grooves, the flow through each groove in a flow distribution module over the width of each module being substantially equal and independent of the specific geometry of channels, to hydrodynamically distribute the flowable material to be sprayed over the length of a distribution module.